ANALYSIS OF HAULAGE FATALITIES IN COAL MINES JANUARY - JUNE 1951

By M. J. Ankeny and D. S. Kingery

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M. J. Ankeny[1/] and D. S. Kingery[2/]

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PART 1. - OCCURRENCE OF FATALITIES IN BITUMINOUS - COAL MINES

INTRODUCTION

This is a study of 58 fatal haulage accidents investigated by Federal coal-mine inspectors during the period January - June 1951. The information presented in this circular was obtained by analyzing fatal haulage accidents in 33 bituminous-coal producing counties representing 11 States. The physical conditions represent a cross section of producing coal beds. Mining and transportation methods vary, from those of small hand-loading mines to those of large modern mechanized operations. These data are thought to be representative of haulage conditions within the bituminous-coal mining industry and are submitted to follow up the Information Circular 7604 "Analysis of Haulage Fatalities in Bituminous-Coal Mines - 1950."

Coal-mine haulage ranks second as a cause of coal-mine fatalities, and the problem of haulage safety is complex. It is subject to constant change and is comprised of numerous influencing variables, which are not always obvious. The solution to this problem will not come through the application of any standard formula or mechanical approach since the inherent factors are strongly influenced by the human equation, and the chain of circumstances is further affected by expediency.

This study was made to illustrate the component parts of haulage accidents and to demonstrate how numerous contributing factors combine to cause haulage injuries. The context also points out the responsibility for such accidents and should be useful to coal-mine safety engineers, mine managers, safety committeemen, and supervisory officials in their efforts to prevent haulage accidents.

SUMMARY

The 58 fatal injuries included in this study occurred at deep mines; 49 occurred underground and 9 on the surface. The occupations of victims and number killed were; brakemen 21, motormen 20, shuttle-car operators 5, railroad-car droppers 3, and nonhaulage personnel 9.

These victims were killed in many different ways. The most frequent were: caught by moving equipment; contact with roof or cross bars; squeezed between haulage equipment and a timber leg, coal rib, or the face; and as the result of runaway equipment or collisions.

The accident rate for brakemen was highest during the ages 25 - 35. With motormen the period was between the ages 30 - 35, holding fairly constant after

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35. The inclination to injury by nonhaulage personnel was fairly constant throughout all age groups.

The ratio of injuries to job experience shows that the less experienced person is very likely to be injured. However, it also indicates that the job-experience range of from 2 to 5 years is critical. This is the period when many individuals accept their work as routine and are considered by management to be experienced. Supervision is reduced, and often the individual is given greater responsibility and a flexible assignment that requires operation under different conditions with various types of equipment.

The total mining experience credited to the victims indicates that a large percentage of persons employed in coal mines have 10 or more years of mining experience. This study shows that safety and safe practices cannot be expected on the basis of experience alone. Experience should be supplemented by regular job-safety instruction and good supervision to reduce accidents.

Most of the haulage accidents (53 percent) occurred on haulage roads; 28 percent occurred in the face areas. Surface accidents accounted for 16 percent, whereas accidents in slopes totaled 3 percent.

The periods during the day when haulage accidents occurred most frequently showed a fairly consistant pattern during the 12 hour period 8:00 a.m. to 8:00 p.m. with the more prominent peaks at noon and toward the end of the first shift. Periods after work stoppage or lunch seem to be more conducive to accidents. This is due to the normal relapse during a period of physical and mental relaxation. Upon returning to active work, the mind is still preoccupied, and, physically, it will take a short period to reach par performance.

The information derived from this study shows a startling parallel with accidents investigated during 1950. While the chain of circumstances vary, the age range and experience of the victims, the manners of occurrence, and contributing factors are quite similar, indicating that haulage accidents recur in a similar manner year after year.

A significant fact is that practically all of these accidents were preventable. More attention to duty, foresight, and common sense, together with greater appreciation of contributing factors will prevent similar accidents.

TABLE 1. - Fatal haulage accidents, 1951, by States

State	Fatal accidents	Percent of accidents investigated
West Virginia	26	44.8
Kentucky	12	20.7
Pennsylvania - bituminous	6	10.3
Alabama	3	5.2
Virginia	3	5.2
Illinois	2	3.5
Ohio	2	3.5
Indiana	1	1.7
Colorado	1	1.7
Utah	1	1.7
North Carolina	1	1.7
Total	58	100.0

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TABLE 2. - Occupation of victims

	Number	Percent of total
Underground:		
Regular brakemen	19	32.7
Temporary brakeman[1]	1	1.7
Regular motormen	12	20.7
Temporary motormen[2]	6	10.3
Regular shuttle-car operators	3	5.2
Temporary shuttle-car operators[3]	2	3.5
Non-haulage personnel	9	15.6
Total	52	89.7
Surface:		
Regular brakeman	1	1.7
Regular motorman	1	1.7
Temporary motorman	1	1.7
Railroad-car droppers	3	5.2
Total	6	10.3
Grand total	58	100.0

1/ This includes a machine operator's helper killed while acting as brakeman.
2/ This includes three officials, a pumper, a timberman, and a mining machine operator killed while operating a locomotive.
3/ This includes a mechanic and a timber-recovery man who were killed while making a short run with a shuttle-car.

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TABLE 3. - Recapitulation of haulage accidents, work classification, and miscellaneous data

Years	Brakemen	Motormen	Nonhaulage personnel	Shuttle-car operators	R.R. car droppers	Total
Age range						
Up to 20.....	0	0	1	0	0	1
20 - 25.....	2	0	0	1	0	3
25 - 30.....	6	1	1	0	0	8
30 - 35.....	6	6	1	0	0	13
35 - 40.....	1	3	2	0	1	7
40 - 45.....	2	3	1	3	0	9
45 - 50.....	1	2	1	0	0	4
50 - 55.....	3	2	1	1	0	7
55 - 60.....	0	1	0	0	2	3
Over 60.....	0	2	1	0	0	3
Average.....	35.2	43.0	40.3	40.2	51.7	39.9
Job experience						
Up to 1.....	3	3	3	3	1	13
1 - 2.....	5	2	1	0	1	9
2 - 5.....	7	9	2	2	0	20
5 - 10.....	1	3	2	0	1	7
10 - 15.....	3	1	1	0	0	5
15 - 20.....	0	0	0	0	0	0
Over 20.....	1	2	0	0	0	3
Average	5.3	5.9	5.2	2.0	2.3	5.1
Total experience						
Up to 1.....	0	0	0	0	0	0
1 - 2.....	0	0	1	1	0	2
2 - 5.....	5	2	2	0	1	10
5 - 10.....	4	4	0	0	2	10
10 - 20.....	7	8	3	3	0	21
20 - 30.....	4	3	2	0	0	9
30 - 40.....	1	1	1	1	0	4
Over 40.....	0	1	0	0	0	1
Average.....	14.8	18.9	15.3	14.0	7.1	15.8
Location						
On haulageroads	15	15	1	0	0	31
In face regions	4	2	5	5	0	16
On surface	1	2	3	0	3	9
On slopes	1	1	0	0	0	2

TABLE 4. - Recapitulation of haulage accidents, time of day

Description	Brakemen	Motormen	Nonhaulage personnel	Shuttle-car operators	R.R. car droppers	Total
Time of day:						
12:00 - 1:00 A.M.....	0	0	0	0	0	0
1:01 - 2:00.....	0	0	0	0	0	0
2:01 - 3:00.....	0	0	0	0	0	0
3:01 - 4:00.....	1	0	2	1	0	4
4:01 - 5:00.....	0	1	0	1	0	2
5:01 - 6:00.....	0	0	0	0	0	0
6:01 - 7:00.....	0	1	0	0	0	1
7:01 - 8:00.....	2	1	0	0	0	3
8:01 - 9:00.....	0	3	1	0	1	5
9:01 -10:00.....	2	1	1	1	0	5
10:01 -11:00.....	1	0	0	0	0	1
11:01 -12:00 Noon.....	0	2	1	0	1	4
12:01 - 1:00 P.M.....	3	0	0	0	0	3
1:01 - 2:00.....	1	1	0	1	0	3
2:01 - 3:00.....	3	3	0	0	1	7
3:01 - 4:00.....	2	1	1	0	0	4
4:01 - 5:00.....	0	1	1	0	0	2
5:01 - 6:00.....	1	1	0	0	0	2
6:01 - 7:00.....	1	0	2	0	0	3
7:01 - 8:00.....	2	1	0	0	0	3
8:01 - 9:00.....	0	2	0	1	0	3
9:01 -10:00.....	1	0	0	0	0	1
10:00 -11:00.....	1	1	0	0	0	2
11:00 -12:00 M. Night.	-	0	0	0	0	0

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CAUSES OF HAULAGE ACCIDENTS

	Occurrence
1. Victim fell or stumbled and was caught by moving equipment.....	14
(a) Action of the victim	
1. Fell from locomotive or shuttle-car.....	3
2. Working ahead of moving equipment.....	3
3. Working on or around moving equipment.....	3
4. Getting on or off of moving equipment.....	2
5. Riding front bumper of first car on pushed trip.....	2
6. Jumping from defective locomotive.....	1
2. Victim was killed by runaway equipment.....	9
(a) Primary causes	
1. Operating on grades without enough retarding devices.....	4
2. Starting trip at high rate of speed.....	2
3. Improperly blocked standing cars.....	2
4. Overloaded trip.....	1
3. Victim was killed as a result of contact with roof or crossbars...	9
(a) Action of the victim	
1. Riding on loaded cars or between cars.....	4
2. Rising up in locomotive or shuttle car.....	2
3. Not watching the direction of travel.....	1
4. Inexperienced operator.....	2
4. Victim was killed as the result of collision of equipment.....	6
(a) Action of the victim	
1. Struck by runaway or moving haulage equipment.....	3
2. Operating equipment that struck parked or moving haulage equipment.....	2
3. Operating equipment that struck parked machinery.....	1
5. Victim was squeezed between haulage equipment and timber leg, rib, or face.....	8
(a) Primary cause	
1. Lack of clearance or obstructed clearance.....	4
2. Failure to take precautions while working in room or at working face.....	2
3. Standing while operating equipment.....	1
4. Not looking in the direction of travel.....	1

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	Occurrence
6. Victim was killed as the result of derailments	6
(a) Action of the victim	
1. Riding equipment that derailed	3
2. Struck by derailed equipment while standing by switch	2
3. Unsafe and improper rerailing procedure	1
7. Victim was squeezed between railroad cars	3
(a) Primary cause	
1. Railroad cars parked on switch and protruding into clearance space	3
8. Miscellaneous	3

Accident prevention, to be effective, should be based upon the concept that haulage accidents are caused by either unsafe conditions, unsafe practices, or a combination of these. The nature of mining is such that physical hazards occur in many different forms, which complicate the job of the transportation man and add to the hazards of his work. The transportation employee should learn to recognize and avoid these conditions and management should work toward their correction.

Some form of physical or operating hazard was evident in more than 51 percent of the fatalities included in this study and was considered the primary cause of 35 percent. Unsafe practices, either involuntary acts or deliberate chance, were evident in more than 65 percent of the accidents and were considered to be the primary cause of 42 percent Unsafe practices and conditions jointly accounted for the remaining 23 percent. The most prevalent and recurring physical hazards and unsafe practices are listed below:

Physical Hazards

	Percent of occurrences
1. Overhead clearance less than 24 inches	17
2. Side clearance less than 24 inches from moving equipment	16
3. Substandard track or roadway	15
4. Irregular grades requiring retarding devices and extra precautionary measures	14
5. Haulage layout lacking common warning or protective devices	12
6. Irregular and protruding ribs	7
7. Lack of communication or control system	3

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	Percent of occurrences
8. Defective locomotive (electrical).....	3
9. Miscellaneous.....	13
	100

Unsafe Practices

	Percent of occurrences
1. Riding in unsafe position.....	15
2. Excessive speed.....	9
3. Failure to comply with instructions or safety rules.....	9
4. Failure to use the normal number of skids or retarding devices...	9
5. Not looking in the direction of travel.....	8
6. Standing or working in exposed places.....	7
7. Coupling or uncoupling cars in motion.....	5
8. Failure to take common precautionary measures while operating equipment.....	5
9. Getting on or off moving equipment.....	5
10. Failure to signal or disregard of signals.....	5
11. Pushing trips on main haulage road.....	5
12. General hazardous practices.....	18
	100

RESPONSIBILITY FOR HAULAGE ACCIDENTS

Due to the chain of circumstances that surround many accidents and the fact that witnesses are sometimes lacking, it is often difficult to define just where management or employee responsibility starts or stops. In this study, responsibility was allocated from the following premises:

Management

a. Should accept responsibility for the physical conditions of the mine.

b. Should layout and operate the haulage system in the best interests of safety.

c. Should provide equipment and auxiliary aids suitable for the job.

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d. Should maintain equipment in serviceable condition.

e. Should accept responsibility for the selecting, training, directing, and disciplining of haulage employees.

The individual

a. Should operate equipment safely.

b. Should not practice acts known to be hazardous.

c. Should comply with instructions to the best of his ability.

d. Should cooperate with the company's safety policy.

Joint responsibility is defined as:

A combination of unsafe acts with physical conditions that bring about an accident, assuming the act or condition alone would not have caused the injury.

Management Responsibility

	Fatalities resulting
1. Maintaining a haulage system that made it difficult to control trips, necessitated unsafe practices, and introduced unnecessary hazards	9
2. Permitting unsafe conditions and short cuts by haulage crews that resulted in the death of a coal loader, boom operator, and motorman	3
3. Failure to provide adequate continuous overhead clearance, resulting in the death of two shuttle-car operators and a motorman	3
4. Action by the responsible supervisor who ordered a motor trip on the haulage road and was not available when the man-trip called for road clearance	1
5. Maintaining a physically unfit man as motorman after the extent of his condition was known	1
6. Failure to properly maintain haulage equipment	1
7. Condoning the regular practice of riding the front bumper of a loaded trip up the slope for an early quit	1
8. Permitting an inexperienced man to work when he had demonstrated his inability to operate equipment	1

Management responsibility accounted for 35 percent of the fatal accidents.

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Individual Responsibility

	Fatalities resulting
1. Running or working ahead of moving locomotives and trips.....	3
2. Failure to use the normal amount of skids and starting the trip at a fast pace.....	3
3. Failure to realine switch after passing.....	2
4. Riding the front bumper of the first car of a pushed trip.....	2
5. Riding on top of a loaded car to save walking a short distance...	2
6. Failure to get in clear or take normal precautionary measures around moving trips.....	2
7. Failure to secure a dangling coupling pin properly, which subsequently caught and upset a dolly car.....	1
8. Hazardous rerailing procedure - pushing a car by means of a short rail between the car and locomotive.....	1
9. Endeavoring to push a trip clear of the switch by using a tie between the car and locomotive.....	1
10. Failure to comply with direct instructions pertaining to the safe performance of the job.....	1
11. Failure by victim to be seated before starting equipment.....	1
12. Failure by motorman to couple a car, standing on slope and containing men, to the locomotive before removing blocks.....	1
13. Failure to properly block standing cars that subsequently ran away.....	1
14. Bending down to block a trip at the loading head without advising the shuttle-car operator.....	1
15. Uncoupling moving cars by standing with one foot in the car and the other foot on bumper of the other car.....	1
16. Joint inattention and thoughtlessness by both the victim loading coal at the face and the motor crew who pushed a trip of cars into the working place.....	1
17. Running at excessive speed.....	1

Individual responsibility accounted for 42 percent of the fatal accidents.

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Joint Responsibility

	Fatalities resulting
1. Lack of a danger zone or warning devices combined with the failure of the individual to take normal precautions while doing hazardous work	3
2. General unsafe shuttle-car practices in the presence of overhanging ribs	2
3. Lack of emergency-control devices combined with the inattention of the victim	1
4. Lack of planning for a new haulage setup combined with individual failure to take the usual precautionary measures	1
5. Standing up on a moving trip to uncouple cars in the presence of irregular overhead clearance	1
6. Riding in an unsafe position and failure to take precautions while rounding a curve. The dispatching and communicating system was deficient	1
7. Traveling at high rate of speed over a point of poor track	1
8. The victim needlessly stood in an exposed position during trip movement and was caught at a point of tight clearance	1
9. The victim fell from the cab of the locomotive and was killed. Cause unknown	2

Joint and unknown responsibility accounted for 23 percent of total fatalities.

RECOMMENDATIONS

The physical hazards and unsafe practices listed imply their own corrective measures. However, their elimination is complicated by numerous indefinite influencing factors. It is doubtful if any standard formula or physical solution can be developed to solve all contributing and not always obvious agents. The solution must come through sincere effort and cooperation by both management and employees striving together toward the common goal.

Management has the primary responsibility for haulage safety. The following suggestions are made to management with the thought that compliance will reduce haulage accidents.

1. Select transportation employees on the basis of physical ability, mental qualifications, and stability.

2. Establish some form of job-safety training and certification for transportation employees. Train relief employees frequently to assure their competence.

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3. Promulgate a reasonable set of safety rules, suitable to conditions, to govern the actions of haulage employees.

4. Conduct regular meetings between officials and haulage employees where ideas concerning safety and efficiency can be discussed, good suggestions be acted upon immediately.

5. Plan the haulage system on the basis of present and projected requirements. Consider the type of haulage equipment in use or anticipated.

6. Establish a preventive maintenance program whereby defective haulage equipment is taken out of service before it breaks down.

7. Improve supervision of haulage employees to assure corrective measures and necessary job instruction.

8. Provide the necessary accessories for safe operation, such as skids or retarding devices, rerailers, lifting jacks, fire extinguishers, and other safety equipment.

9. Establish a positive communication or dispatching system with safety auxiliaries, such as automatic traffic-control blocks, signals, and switches.

10. Provide safety-designed equipment that permits a comfortable and safe place for workers to ride.

11. Promulgated standards on the basis of engineering and safety knowledge to govern the layout, installation, and maintenance of haulageways, shafts, and slopes, with emphasis on the following:

(a) Track standards. - alinement, gradient, size of rails, ballasting, drainage, maintenance, etc.

(b) Haulage roads. - vertical clearance over equipment, side clearance, shelter holes, trolley wire, electrical installations, illumination, and timbering.

Employees should accept joint responsibility for many of the previous recommendations, and, in the interest of their own safety, they should also comply with the following suggestions:

1. Study the job, analyze and plan operations for maximum safety.

2. Study the equipment; learn its performance, limitations, and safe operating conditions.

3. Check equipment for malfunction before starting work.

4. Study potential hazards; how they occur, when they occur, and corrective measures.

5. Comply with instructions to best of ability.

6. Consult foreman when unfamiliar with proper procedures.

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7. Report all hazards and deficiencies to officials.

8. Cooperate with company safety policy at all times.

9. Be sure that all signals are understood before acting.

10. Always keep operated equipment under control.

11. When operating equipment, consider the potential hazards to other workers.

12. Develop safety consciousness for personal safety as well as the safety of others.

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PART II. - OCCURRENCE OF FATALITIES IN ANTHRACITE COAL MINES

INTRODUCTION

During the first six months of 1951, seven fatal accidents were investigated at anthracite mines. Three separate coal producing companies were involved. Company No. 1 experience four accidents, two occurring at the same mine. Company No. 2 experienced two accidents. Company No. 3 experienced one accident. The causes and manner of occurrence of these accidents were similar to those described in bituminous-coal mines. Salient data pertaining to these accidents is as follows:

TABLE 5. - Recapitulation of data: Haulage accidents in anthracite-coal mines

Work classification	Age	Experience on job	Total mine experience	Location	Size of mine, tons per day	Time of accident
Underground						
Motorman 1	36	9	12	slope	2,168	4:30 p.m.
Motormen 2	58	14	40	gangway	995	1:00 p.m.
Triprider 1	47	7	20	gangway	840	5:45 p.m.
Triprider 2	39	9	9	near shaft bottom	3,295	8:45 a.m.
Bottom man	58	1	42	bottom landing	1,400	1:15 a.m.
Miner	52	12	26	chamber	2,826	12:20 p.m.
Surface						
Tipple employee	65	10	not available	surface railroad	3,700	1:30 p.m.
Average	51	9	25			

DESCRIPTION OF ACCIDENTS

1. The victim, a motorman, was killed while riding with three other men on the bumpers of a loaded car being pulled up the slope. The car was derailed, and the victim was thrown and squeezed between the car and timbers. The other men were uninjured.

2. The victim, operating a storage-battery locomotive, was gathering loads along a rock gangway. He pushed the accumulated loads from four working places up the 2-1/2 percent gangway, holding the trip with the locomotive since all the cars were not coupled. Evidently, the fuse on the locomotive burned when the trip bumped the last var in the gangway. The rails were wet and the victim was unable to control the trip by means of the hand brake. He was killed as a result of the runaway.

3. The victim, a triprider, was run over by a pushed trip while preceding this trip up a gangway. There were no witnesses to the accident, and what caused the victim to be caught could not be determined. Regular haulage practice was for the triprider to proceed a slowly pushed trip to warn any miners in the gangway. Visibility for the motorman was limited by curves.

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4. The victim, a triprider, evidently not thinking for the moment, walked between the last two cars of a 30 car trip while they were approaching a switch. He was dragged 32 feet and died from resulting injuries.

5. The victim, a bottom man working with a helper and locomotive crew, made up the team that was sending empty mine cars to the surface. The procedure was to couple the first two cars of the trip to the accommodation car, hoist the cars, then push the trip forward two cars and repeat the operation. When only ten cars remained, the haulage crew pushed three additional cars to the trip. The first car had a damaged center coupling so it was not coupled to the other two, although a side coupling could have been made. While pushing these cars, this free car ran away and bumped the rear of the standing ten cars just as the victim was bending down to couple the first car to the accommodation car. The victim's head was crushed between the accommodation car and the first car. There was a 4-inch space between the cars since the victim was coupling from the inside of a curve, and the accommodation car was setting to a slight degree on the slope.

6. The victim, a miner, suffered a crushed skull while attempting to couple a standing loaded car to an empty car connected to the locomotive. The cause was not known definitely; either the loaded or the empty car and locomotive were moved, causing the ends of the cars to come together.

7. The victim, a tipple employee, saw from the inspection platform that a car of "buck wheat" coal was leaking. Without instructions and without informing his co-workers, he crawled under the car to patch the leak. He was killed when the railroad car was moved away from the inspection platform by a car dropper.

Int. - Bu. of Mines, Pgh., Pa.

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